

in Oklahoma, Texas, and Arkansas, since March of the present year.

The largest monthly amount reported by any one station in the United States proper was 25.10 inches at Seven Hills, in Mobile County, Ala.

#### SUNSHINE AND RELATIVE HUMIDITY

The sunshine was of more than usual quantity during July in nearly all sections, even in most areas where the precipitation was heavy. The amount of sunshine was particularly large in the far Northwest and the upper

Mississippi Valley; elsewhere it was usually equal to or moderately more than normal, but some portions of the central and eastern Lake region, the Ohio Valley and the Rio Grande Valley had less sunshine than normal.

The relative humidity was above normal in much of the Middle Atlantic and New England area, and often near the east Gulf coast and near the Rio Grande. Practically all other districts had less humidity than normal, the shortage being large in the middle and northern portions of the Plateau and Rocky Mountain regions, in most of the Plains and in the upper Mississippi Valley.

#### SEVERE LOCAL STORMS, JULY, 1931

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards <sup>1</sup>	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Fort Wayne, Ind.	1	12:25 p. m.			\$1,700	Thunderstorm	Power lines damaged; traffic delayed; large building of lumber company blown down; windows broken.	Official U. S. Weather Bureau.
Goff (near), Kans.	1	12:30 p. m.	1,500		4,000	Tornado	Chief damage to large barn and small farm buildings; livestock killed or injured; path 1 mile long.	Do.
Indianapolis (near), Ind.	1	1 p. m.				do	Occurred near airport, no damage reported.	Do.
Darlington, Wis., and vicinity.	1	5:30 p. m.	880		25,000	do	Character of damage not reported.	Do.
Port Arthur, Tex.	1	6 p. m.		1	73,000	Thunderstorm	Lightning caused explosion and fire on oil barge.	Do.
Bradford, Cumberland, Lancaster, Lebanon, and Dauphin Counties, Pa.	1	P. m.			300,000	Severe thunderstorm, wind and hail.	Many houses unroofed; heavy crop damage.	Do.
Boone and Grundy Counties, Iowa.	1	P. m.			17,000	Wind and hail	Buildings and crops damaged.	Do.
Tony (near), Wis.	1	P. m.			8,000	Tornado	Large barn destroyed and another damaged.	Do.
Audubon, Black Hawk, Bremer, Carroll, Cerro Gordo, Clay, Greene, Guthrie, Hamilton, Hancock, Harrison, Kossuth, and Marion Counties, Iowa.	1					Wind	Crops flattened; buildings damaged; a few poles blown down.	Do.
Beattie, Kans.	1				500	Probably tornado.	Barns and fruit trees damaged.	Do.
Indianapolis, Ind.	1					Thunderstorm	2 houses struck by lightning; number of power and light poles damaged or blown down.	Do.
Marshall and Pocahontas Counties, Iowa.	1				55,000	Hail	Chief damage to crops.	Do.
Maryland (central and western).	1					Wind	Trees blown down or broken off; buildings damaged.	Do.
Mounds, Ill.	1					do	Plate glass windows broken; trees, roofs, and small buildings damaged.	Do.
Pratt County, Kans.	1				50,000	do	Wheat badly twisted and blown down; minor damage to buildings.	Do.
Beckemeyer and Posey, Ill.	2	4 p. m.	4 mi.			do	Homes, outbuildings, and trees damaged; crops injured; path 10 miles long.	Do.
Buffalo, N. Y., and vicinity.	2				36,000	do	Buildings, hangar, and 5 planes damaged.	Do.
Memphis, Tenn., and vicinity.	2				85,000	Thunderstorm	Schoolhouse and business building severely damaged.	Do.
Spearville (near), Kans.	2				5,000	Hail	Character of damage not reported; area about 5 square miles.	Do.
Tama County, Iowa.	2				3,000	Wind	Barns and other small buildings damaged.	Do.
Grand Junction, Colo.	3	5:04 - 5:13 p. m.	2 mi.		15,000	Hail	Damage chiefly to apples, melons, and tomatoes.	Do.
Sanders County, Mont.	3				1,500	do	Roofs, auto tops, etc., damaged.	Do.
Wilson, Hazen, and Slovaktown, Ark.	3				20,000	Wind	Character of damage not reported.	Do.
Brown and Jackson Counties, Kans.	4	2:30-3 p. m.	3 mi.		20,000	Hail	Details not reported; path 10 miles long.	Do.
Barber, Harper, Sumner, Kingman, and Sedgwick Counties, Kans.	4	2:30 - 3:30 p. m.				Wind	Chief damage at airport at Wichita; path 80 miles long.	Do.
Rogers, Ark., and vicinity.	7				15,000	Hail	Character of damage not reported.	Do.
Hamilton, Webster, and Dubuque Counties, Iowa.	8	2:30-3 p. m.			48,000	Hail and wind	Considerable damage to buildings and crops.	Do.
Tyrone (near), Okla.	8	5 p. m.	1-2 mi.		25,000	Hail	Damage mainly to crops; path 4 miles long.	Do.
Cooke, Grayson, Collin, and Fannin Counties, Tex.	8	P. m.			3,800	Wind	Buildings unroofed; crops hurt.	Do.
Lyon and Story Counties, Iowa.	8	P. m.			40,000	Hail	Considerable crop loss.	Do.
Albuquerque, N. Mex. (10 miles east).	9	12:15 p. m.				Probably tornado.	No details reported.	Do.
Alliance, Nebr.	9	2-3 p. m.	4 mi.		60,000	Hail	Considerable damage to crops and some loss of livestock; path 5 miles long.	Do.
Jonesville, Va.	9	3:30 p. m.	1.5 mi.		12,000	Hail and rain	Crops hurt; soil washed; buildings and bridges damaged.	Do.
Benton, Buchanan, Delaware, Dubuque, Franklin, Johnson, Linn, Mitchell, Polk, and Tama Counties, Iowa.	9				156,000	Hail	Crops total loss in some places; poultry killed.	Do.
Pennsylvania (north central and northeastern).	9					Rain and electrical.	Cellars flooded; bridges washed away; heavy crop loss.	Do.
Waukesha County, Wis.	10				5,000	do	Considerable damage, chiefly to crops.	Do.
Belleville to Cuba, Kans.	11	5 p. m.	2 mi.		8,000	Hail and wind	Trees broken; small buildings, poles, and wires blown down; path 4 miles.	Concordia (Kans.). Blade Empire

<sup>1</sup> "Mi." signifies miles instead of yards.

## Severe local storms, July, 1931—Continued

Place	Date	Time	Width of path, yards <sup>1</sup>	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Rydal and Norway to Clifton and Greenleaf, Kans.	11	5 p. m.	15 mi.		\$11,000	Wind	Chief damage to farm buildings and trees; path 40 miles long.	Official, U. S. Weather Bureau.
Cleburne to Fostoria, Kans.	11	6 p. m.	4 mi.		2,000	do.	Barns and trees damaged.	Do.
Casselton to Mapleton, N. Dak.	11					Hail	Heavy crop damage.	Do.
Hamilton, Harrison, Jasper, Mills, and Pottawattamie Counties, Iowa.	11					do.	Crops total loss in some localities.	Do.
Gage and Jefferson Counties, Nebr.	12	3 p. m.	3-4 mi.		50,000	do.	Crops, windows and roofs damaged; poultry killed; path 10 miles.	Do.
Fremont, Marshall, Page, Tama, and Wayne Counties, Iowa.	12				81,700	Wind and hail	Crops beaten; buildings and cars damaged; livestock killed.	Do.
Six Mile, S. C.	13	9 p. m.			12,000	Thunderstorm	Lightning caused fire, which destroyed store and contents.	Do.
Sky Harbor Airport, Tenn.	13				5,000	Wind	Hanger and trees damaged.	Do.
Philadelphia, Pa., and vicinity.	14	7:30 p. m.			1,000,000	Electrical and rain	Parts of city severely damaged by water; damage by lightning in vicinity.	Do.
Alabama (southwestern)	14-15					Rain and wind	Bridges washed out; large areas inundated; traffic interrupted; telephone lines out of commission; crops damaged.	Do.
Moneta, Va.	14-15				2,000	Severe hailstorms	Character of damage not reported.	Do.
Winnebago County, Ill.	15	12:45 a. m.	1,760		20,000	Wind	Buildings damaged; silos wrecked.	Do.
Anne Arundel County, Md. (southwestern)	15	4 p. m.	880		1,000	Hail	Corn and tobacco hurt.	Do.
Kent County, Md. (northwestern)	15	4 p. m.	2.5 mi.		25,000	do.	Crops, chiefly corn and tomatoes, damaged.	Do.
Richmond, Va.	15	5 p. m.			5,000	Wind and electrical	Buildings damaged; trees suffered; telephones out of commission.	Do.
Davidsonville, Md., and vicinity.	15				4,000	Wind	2 barns and silo wrecked; many trees prostrated.	Do.
Jenison, Mich.	15					Probably tornado, wind and hail.	2 barns wrecked; grain crops leveled; many trees uprooted.	Do.
Rockpoint, Md. (north of Phillips, Sheridan, and Valley Counties, Mont.	15-16				190,300	Hail	Considerable tobacco ruined.	Do.
Oakland, Md.	16	3-4 p. m.	200-880		300	Tornado	Extensive crop damage; much loss of livestock; buildings damaged.	Do.
Richmond, Va.	16	5 p. m.			3,500	Wind and electric	Minor damage to buildings; trees blown down.	Do.
Knoxville, Tenn.	16					Severe thunderstorm.	Telephone service disrupted; trees injured.	Do.
Morgan County, W. Va.	16					Hail	Some sections of city flooded; pavements torn up; traffic interrupted; some damage to buildings by lightning.	Do.
Pittsburgh, Pa.	16				25,000	Thunderstorm and wind.	10,000 bushels of apples ruined.	Do.
Washington County, Md. (eastern).	16		1,760			Hail	Many small buildings unroofed; trees uprooted.	Do.
Chambersburg, Pa.	17	2-2:30 p. m.		1	20,000	Electrical and rain	Windows shattered; roofs pierced; grapevines, fruit and gardens injured; path 10 miles long.	Do.
Sheboygan, Mich.	17	3:40-5 p. m.				Thunderstorm and wind.	Property damaged chiefly by flooding.	Do.
Jackson and O'Brien Counties, Iowa.	17				7,000	Hail and wind	Trees uprooted; small buildings overturned; other minor damage.	Do.
Johnson City (near), Tenn.	17			2		Wind	Crops hurt; minor damage to buildings.	Do.
Lisbon (near), Md.	17				3,500	Electrical	Trees blown down at roadside fair; 8 persons injured.	Do.
Traverse City, Mich.	17				12,000	Wind squall.	Barn and other outbuildings burned.	Do.
Pana, Ill.	18			1		Electrical and wind	Blimp torn from mooring and damaged.	Do.
Wayne, Winneshiek and Linn Counties, Iowa.	19	P. m.			17,500	Wind, hail, and rain.	Barn burned; corn leveled over considerable area.	Do.
Chicago, Ill.	19					Thunderstorm	Crops and buildings damaged; sewers flooded.	Do.
Forestville and Sturgeon Bay, Wis., and vicinity.	19				50,000	Thunderstorm	Streets and basements flooded; traffic delayed; trees uprooted.	Do.
Simpsonville, S. C.	19				1,500	Electrical	Chief loss to cherry orchards.	Do.
Brush, Hillrose, New Raymer, and Snyder, Colo.	20	5:30-8:30 p. m.	2-8 mi.	1	110,000	Hail and wind	Barn and contents destroyed.	Do.
Buffalo, N. Y.	20				75,000	Electrical	Crops hurt; poultry and livestock killed; house wrecked; others damaged; light, telephone, and telegraph poles blown down.	Do.
Clint to Socorro, Tex.	20	2 p. m.	1.5 mi.			Hail	Yacht and soap factory set fire and 3 churches damaged.	Do.
Winneshiek, S. C.	20	P. m.			3,000	Electrical	Crops injured 25 to 50 per cent.	Do.
Marshall County, Ill. (northwestern).	21	3 p. m.	3 mi.		75,000	Hail	Building damaged.	Do.
Quinlan, Tex.	21	3:45 p. m.	440		1,000	Tornado	Heavy crop loss; path 4 miles.	Do.
Diamond Creek to Elm-dale, Kans.	22	4-7 p. m.	1,760		6,000	Hail	Buildings damaged; path 1.5 miles long.	Do.
Catlin, Ill., and vicinity	22	10 p. m.	4 mi.		190,000	do.	Crops injured; path 5 miles long.	Do.
Connecticut (northeastern).	22					do.	Heavy loss to crops; considerable damage to buildings and other property; path 8 miles long.	Do.
Phillips and Roosevelt Counties, Mont.	22					Hail	Considerable damage to tobacco and other crops.	Do.
Calhoun, Jersey, Macoupin, and Pike Counties, Ill.	22-23				423,500	Hail, wind, and electrical.	Buildings and crops damaged; some loss of livestock.	Do.
Montezuma and Fort Byron districts, N. Y.	23	1:30 p. m.	3 mi.		32,000	Hail	Crops severely damaged; schoolhouse and barn burned.	Do.
Ivy Depot, Va. (2 miles west of).	23	P. m.	1,320		5,000	do.	Heavy damage to field crops and buildings.	Do.
Frederick and Washington Counties, Md.	23					do.	Fruit and corn injured.	Do.
Snowflake to Taylor, Ariz.	23					Wind and hail	Much injury to apple and peach crops.	Do.
Unionville, Md.	23				5,000	Electrical	Crops almost total loss.	Do.
Stuttgart, Ark., and vicinity.	23-24				5,000	do.	Barn and contents burned.	Do.
Norfolk, Va.	24	12:30 p. m.				Wind squall	Damage to power lines and equipment.	Do.
Alexandria, La. (Camp Beauregard.)	24	4:30-5 p. m.			15,000	Thundersquall	Many windows broken; trees uprooted.	Do.
Frederick County, Md. (south-central).	24	7 p. m.	880-1,760		20,000	Hail and wind	2 buildings wrecked, 1 moved from foundation; number of tents blown down; airplane demolished; many persons injured.	Do.
Shawnee, Okla. (8 miles northwest).	24	8 p. m.	50			Tornado	Windows and roofs pierced; corn stripped; fruit injured; trees uprooted; path 10 miles long.	Do.
Conway, Ark.	24				3,000	Wind	Damage confined to a few farms.	Do.
Humboldt County, Nebr. (Leonard Creek Ranch.)	24				1,500	Violent dust whirl.	Character of damage not reported.	Do.
							Lambing shed wrecked.	Do.

<sup>1</sup> "Mi." signifies miles instead of yards.

## Severe local storms, July, 1931—Continued

Place	Date	Time	Width of path, yards <sup>1</sup>	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Tuckerton, Pa.	24				\$15,000	Electrical	No details reported	Official, U. S. Weather Bureau.
Maxwell (near), N. Mex.	25		3 mi.		3,000	Hail	Crops hurt; path 8 miles	Do.
Middle Hope and Marlboro, N. Y.	27	5:45 p. m.	1,320		2,000	Wind squall and rain	Vineyards damaged	Do.
Moorhead, Minn., to Fargo, N. Dak.	27				12,000	Wind and hail	Crops and buildings damaged	Do.
Ganado to Fort Defiance, Ariz.	28	6 p. m.	4 mi.	3	275,000	Hail and rain	Severe loss to crops and stock; buildings and irrigation dam damaged	Do.
Berenville, Pa.	29				10,000	Electrical	No details reported	Do.
Colchester and Winooski Valley, Vt.	29					Wind and rain	Trees and weak buildings blown down; crops hurt	Do.
Lindrieth, N. Mex.	30					Hail and rain	Corn and bean crops considerably damaged	Do.
Pomeroy (near), Wash.	30					Hail	Standing grain damaged 50 per cent	Do.
Fillmore and Saline Counties, Nebr.	31	2-3 p. m.	2 mi.		10,000	do.	Damage to crops estimated at 50 per cent in places; path 16 miles long	Do.
Dallas County, Iowa	31	2:30 p. m.			4,100	Wind and hail	Buildings and crops damaged	Do.
Harmony, Nebr.	31	7 p. m.				Small tornado	A few outbuildings destroyed	Do.

<sup>1</sup> "MI." signifies miles instead of yards.

## RIVERS AND FLOODS

(River and Flood Division, Montrose W. Hayes in charge)

By RICHMOND T. ZOCH

The only overflows of consequence in the principal rivers of the United States during July, 1931, were those in the Pascagoula and Pearl River systems of Mississippi. These floods caused damage to the extent of \$165,000, most of which was the result of 25,000 acres of prospective crops being inundated. The money value of property saved by warnings was estimated at \$5,000.

The usual table of flood stages which occurred at Weather Bureau gaging stations appears herewith. No damage was reported at any of these places except that mentioned in the preceding paragraph.

Heavy local rains caused numerous overflows in creeks and small streams where it is impracticable to maintain warning service. Damages were reported (but the extent or amount was not given) at Bremen, Ohio, on July 2, at Cawker City, Kans., on July 6, in central Vermont on July 22, at Portsmouth, Ohio, on July 23, at Pocatello, Idaho, on July 29, and at Helena, Mont., and Cheyenne, Wyo., on July 30. On July 9 severe local rains caused floods in small streams in and around Scranton, Pa. The damage was estimated at \$50,000. On July 14 a severe storm caused floods in the small streams in and around Philadelphia, Pa. The damage was estimated at \$1,000,000.

The Mississippi River and nearly all of its tributaries remain at very low stages.

Table of flood stages in July, 1931

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE					
Susquehanna: Oneonta, N. Y.....	<i>Feet</i> 12	11	11	<i>Feet</i> 12.0	11
Neuse: Smithfield, N. C.....	14	5	5	14.2	5
Santee: Rimini, S. C.....	12	13	13	12.2	13
EAST GULF OF MEXICO DRAINAGE					
Chickasawhay: Enterprise, Miss.....	21	28	30	22.1	29
Pearl: Jackson, Miss.....	20	28	31	22.3	31
MISSISSIPPI SYSTEM					
<i>Red Basin.</i>					
Sulphur: Ringo Crossing, Tex.....	20	26	26	20.4	26
WEST GULF OF MEXICO DRAINAGE					
Rio Grande:					
Riogrande, Tex.....	21	19	19	23.5	19
San Benito, Tex.....	23	20	22	24.7	21
Brownsville, Tex.....	18	21	22	18.5	22
GULF OF CALIFORNIA DRAINAGE					
Colorado: Parker, Ariz.....	{ 7	1	1	7.0	1
	{	8	14	7.2	9-11

## WEATHER OF THE ATLANTIC AND PACIFIC OCEANS

By the Marine Division, W. F. McDONALD in charge

## NORTH ATLANTIC OCEAN

By W. F. McDONALD

The average barometric pressures over the Atlantic and its adjacent coasts during July, 1931, did not depart greatly from the monthly normals except over Iceland, the British Isles, and Scandinavia, where the barometer averaged considerably below normal. From Halifax to the Spanish Peninsula there was a slight excess in average air pressure, and a slight deficiency from the Caribbean region to Bermuda and New England. (See Table 1.)

These conditions represent a displacement northeastward of the Atlantic centers of action during July, with some intensification of the usually inactive center of low pressure over the northeastern Atlantic, which is reflected in the fact that the British Isles experienced unusually cloudy and unsettled weather.<sup>1</sup> The pressure over southern Greenland (Julianehaab) continued above normal though not up to the extraordinary height shown by

average pressure in the preceding month when the mean barometer was 30.07 inches.

TABLE 1.—Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, July, 1931

Stations	Average pressure	Departure	High-est	Date	Low-est	Date
	Inches	Inch	Inches		Inches	
Julianehaab, Greenland <sup>1</sup>	29.94		30.32	9th	29.53	1st.
Reykjavik, Iceland <sup>1</sup>	29.71	-0.12	30.10	7th	29.36	23d.
Aberdeen, Scotland <sup>2</sup>	29.68	-0.24	30.01	1st.	29.33	27th.
Valencia, Ireland <sup>2</sup>	29.63	-0.15	30.20	21st.	29.52	14th.
Lisbon, Portugal <sup>1</sup>	29.67	+0.05	30.30	25th.	29.94	22d.
Madeira <sup>1</sup>	30.11	-0.02			29.95	22d.
Horta, Azores <sup>1</sup>	30.34	+0.07	30.52	1st.	30.08	10th.
Belle Isle, Newfoundland <sup>1</sup>	29.83	-0.04	30.38	8th.	29.38	5th.
Halifax, Nova Scotia <sup>1</sup>	29.86	+0.01	30.26	10th.	29.62	31st.
Nantucket <sup>2</sup>	29.93	-0.05	30.13	13th.	29.52	22d.
Hatteras <sup>2</sup>	29.96	-0.05	30.16	14th.	29.75	22d.
Bermuda <sup>1</sup>	30.09	-0.04	30.28	25th.	29.86	4th.
Turks Island <sup>1</sup>	30.05	-0.02	30.18	12th.	29.96	1st.
Key West <sup>1</sup>	29.97	-0.06	30.10	20th.	29.85	9th.
New Orleans <sup>2</sup>	29.96	-0.04	30.15	30th.	29.73	15th.

<sup>1</sup> All data based on a. m. observations only, with departure computed from best available normals related to time of observation.

<sup>2</sup> Corrected 24-hour means, based on more than one observation daily.

<sup>3</sup> Highest and lowest from one observation daily (a. m. only).

<sup>1</sup> Monthly Supplement to the Daily Weather Report. British Meteorological Office July, 1931.